

US-PAT-NO: 6835956

DOCUMENT-IDENTIFIER: US 6835956 B1

TITLE: Nitride semiconductor device and manufacturing method thereof

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6835956

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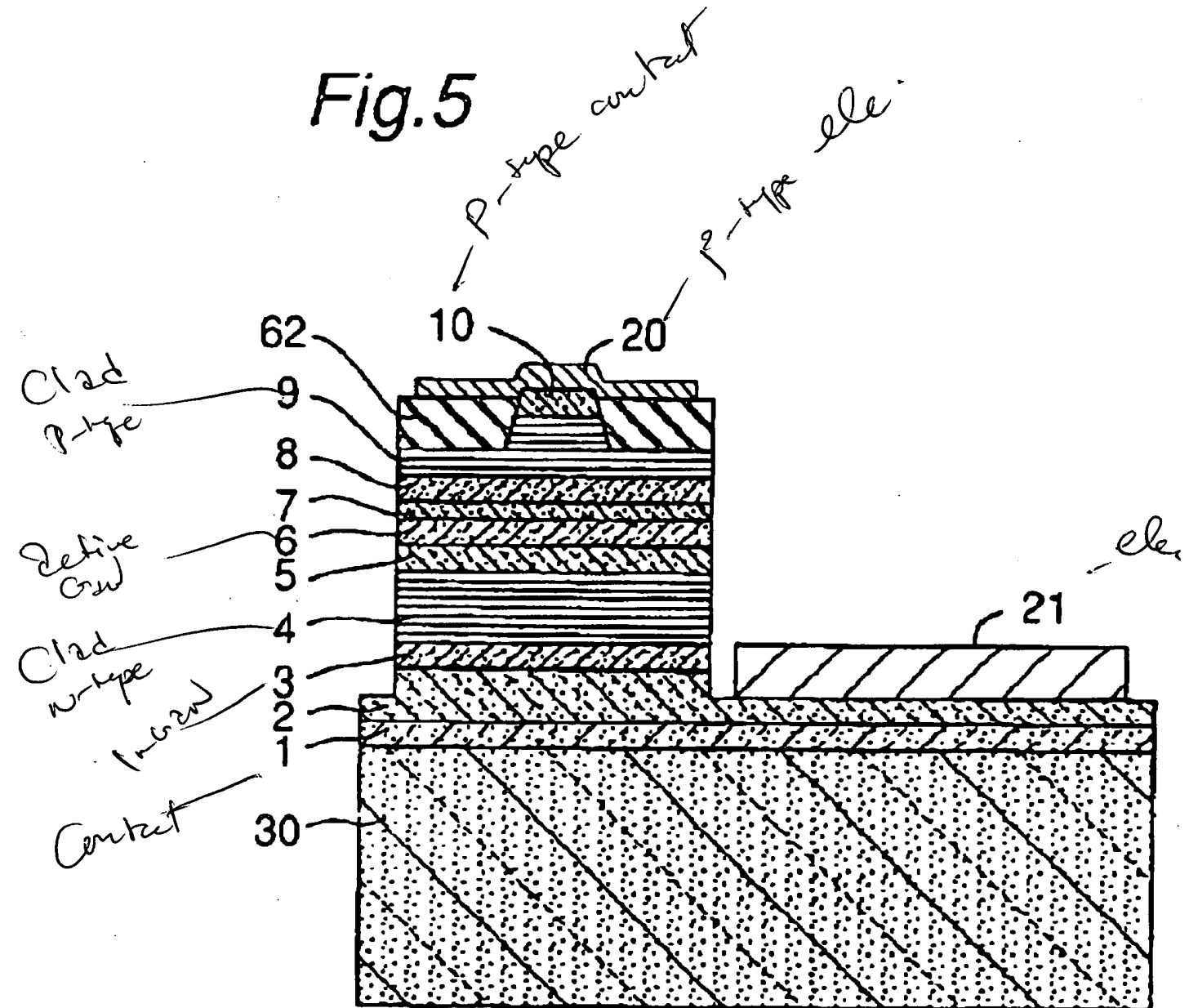
Detailed Description Text - DETX (29):
(Undoped n-type Contact Layer 1:Al.sub.a G.sub.1-a N of the Present Invention)

Detailed Description Text - DETX (30):
An undoped n-type contact layer 1 made of undoped Al.sub.0.05 Ga.sub.0.095 N was grown to the thickness of 1 .mu.m on the GaN substrate 30, using TMA (trimethylaluminium), TMG and ammonia gas as a source gas at 1050.degree. C. (n-type contact layer 2: Al.sub.a Ga.sub.1-a N of the present invention)

Detailed Description Text - DETX (32):
Now, there were no small cracks in the above-mentioned n-type contact layer (including the n-type contact layer 1), thus the cracks can be prevented well. If there are any small cracks in the GaN substrate, the small cracks can be prevented from propagating by growing the n-type nitride semiconductor layer 2, so as to grow a device structure having a good crystallinity. The crystallinity was enhanced better in the case that both an n-type contact layer 2 and an undoped n-type contact layer 1 are formed as described above, compared with the case that only the n-type contact layer 2 was formed.

Detailed Description Text - DETX (63):
The laser device was fabricated in the same manner as in Example 1, except that the undoped n-type contact layer 1 was not grown and only the n-type contact layer 2 was grown.

Fig. 5





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(12) **United States Patent**
Nagahama et al.

(10) Patent No.: **US 6,835,956 B1**
(45) Date of Patent: **Dec. 28, 2004**

(54) **NITRIDE SEMICONDUCTOR DEVICE AND MANUFACTURING METHOD THEREOF**

(75) Inventors: **Shinichi Nagahama, Anan (JP); Shuji Nakamura, Anan (JP)**

(73) Assignee: **Nichia Corporation, Tokushima (JP)**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/500,288**

(22) Filed: **Feb. 8, 2000**

(30) **Foreign Application Priority Data**

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Nov. 22, 1999 (JP) P 11-331797

(51) Int. Cl.⁷ **H01L 27/15**

(52) U.S. Cl. **257/79; 257/13; 257/82; 257/85; 257/94; 257/101; 257/103**

(58) Field of Search **257/79, 80, 94**

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Primary Examiner—Long Pham

Assistant Examiner—Wai-Sing Louie

(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye PC

(57) **ABSTRACT**

A nitride semiconductor device includes a GaN substrate having a single-crystal GaN layer at least on its surface and plurality of device-forming layers made of nitride semiconductor. The device-forming layer contacting the GaN substrate has a coefficient of thermal expansion smaller than that of GaN, so that a compressive strain is applied to the device-forming layer. This result in prevention of crack forming in the device-forming layers, and a lifetime characteristics of the nitride semiconductor device is improved.

8 Claims, 4 Drawing Sheets

